

Claims

- [c1] 1. A porous silica particle for use in zwitterionic and hydrophilic interaction high performance liquid chromatography, comprising covalently bound zwitterionic groups.
- [c2] 2. A silica particle according to claim 1, wherein said zwitterionic groups are grafted on the particle.
- [c3] 3. A silica particle according to claim 2, wherein zwitterionic groups are polymerized to said zwitterionic groups grafted on the particle; and
the number of zwitterionic groups polymerized to said zwitterionic groups grafted on the particle is greater than the number of said zwitterionic groups grafted on the particle.
- [c4] 4. A silica particle according to claim 1, wherein said zwitterionic groups contain polymeric chains of at least two zwitterionic monomers.
- [c5] 5. A silica particle according to claim 4, wherein said polymeric chains are built up of a zwitterionic monomer selected from the group consisting of
3-[N,N-dimethyl-N-(methacryloyloxyethyl)ammonium]

propanesulfonate, 1-(3-sulfopropyl)-2-vinylpyridinium betaine, and
3-[N,N-dimethyl-N-(methacrylamidopropyl)ammonium]
propanesulfonate.

[c6] 6. A column packing material suitable for use as a stationary phase in zwitterionic and hydrophilic interaction high performance liquid chromatography, comprising porous silica particles, wherein said porous silica particles comprise covalently bound zwitterionic groups.

[c7] 7. A column packing material according to claim 6, wherein said zwitterionic groups have been grafted on said porous silica particles.

[c8] 8. A column packing material according to claim 7, wherein zwitterionic groups are polymerized to said zwitterionic groups grafted on said porous silica particles; and
the number of zwitterionic groups polymerized to said zwitterionic groups grafted on said porous silica particles is greater than the number of said zwitterionic groups grafted on said porous silica particles.

[c9] 9. A column packing material according to claim 6, wherein said covalently bound zwitterionic groups comprise polymeric chains of at least two zwitterionic

monomers.

- [c10] 10. A column packing material according to claim 9, wherein said polymeric chains are built up of a zwitterionic monomer selected from the group consisting of 3-[N,N-dimethyl-N-(methacryloyloxyethyl)ammonium] propanesulfonate, 1-(3-sulfopropyl)-2-vinylpyridinium betaine, and 3-[N,N-dimethyl-N-(methacrylamidopropyl)ammonium] propanesulfonate.
- [c11] 11. A method for producing porous silica particles for zwitterionic and hydrophilic interaction high performance liquid chromatography, comprising:
providing porous silica particles suitable for use in zwitterionic and hydrophilic interaction high performance liquid chromatography;
reacting said silica particles with thionyl chloride, thereby obtaining activated silica particles;
reacting said activated silica particles with a tert-(C4-C10)-alkyl hydroperoxide to couple said tert-(C4-C10)-alkyl hydroperoxide to said activated silica particles, thereby obtaining peroxide-functionalized silica particles; and
adding a zwitterionic methacryloyloxyethyl monomer to said peroxide-functionalized silica particles, thereby initiating graft polymerization of said zwitterionic

methacryloxyethyl monomer to said peroxide-functionalized silica particles, wherein the porous silica particles comprise covalently bound zwitterionic groups.

[c12] 12. A method according to claim 11, wherein the zwitterionic methacryloxyethyl monomer is 3-[N,N-dimethyl-N-(methacryloyloxyethyl)ammonium]propanesulfonate.

[c13] 13. A method for producing porous silica particles for zwitterionic and hydrophilic interaction high performance liquid chromatography, comprising:
providing porous silica particles suitable for use in zwitterionic and hydrophilic interaction high performance liquid chromatography;
suspending the silica particles in an aqueous solution of a zwitterionic methacryloxyethyl monomer, thereby obtaining a suspension of silica particles;
allowing said suspension to equilibrate at room temperature;
heating said equilibrated suspension to a temperature at or between 40°C and 70°C; and
adding an aqueous solution of ammonium cerium nitrate, thereby initiating polymerization, wherein the porous silica particles comprise covalently bound zwitterionic groups.

[c14] 14. A method according to claim 13, wherein the zwitterionic methacryloxyethyl monomer is 3-[N,N-dimethyl-N-(methacryloyloxyethyl)ammonium]propanesulfonate.